3 SEM TDC PHY M 1

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(November)

PHYSICS

(Major)

Course : 301

(Optics)

Full Marks : 60

Pass Marks : 24/18

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer from the following :   1×6=6

(a) Huygens' eyepiece consists of two planoconvex lenses of focal lengths

   (i) $3f$ and f, separated by $2f/3$

   (ii) $3f$ and f, separated by $2f$

   (iii) f and f, separated by $3f/2$

   (iv) None of the above

(Turn Over)

(b) In Young's double-slit experiment, the separation between the slits is halved and distance between the slits and screen is doubled. The fringe width is

(i) unchanged

(ii) halved

(iii) doubled

(iv) quadrupled

(c) The coherent sources required for formation of Newton's rings are produced by the method of

(i) division of wavefront

(ii) division of amplitude

(iii) division of frequency

(iv) None of the above

(d) The expression $f_n = \frac{r_n^2}{n\lambda}$ refers to an optical instrument known as

(i) Michelson interferometer

(ii) zone plate

(iii) Huygens' eyepiece

(iv) None of the above

(e) The width of the diffraction band varies

(i) inversely as the wavelength

(ii) directly as the width of the slit

(iii) directly as the distance between the slit and the screen

(iv) inversely as the size of the source from which the slit is illuminated

(f) An optically active compound

   (i) rotates the plane polarized light

   (ii) changes the direction of polarized light

   (iii) does not allow plane-polarized light to pass through

   (iv) None of the above

2. *(a)* Draw a neat ray diagram of formation of image in Cassegrainian telescope.   2

   (b) An achromatic telescope objective of $1 \cdot 5$ m focal length consists of two thin lenses in contact with each other and their dispersive powers are $0 \cdot 05$ and $0 \cdot 075$ respectively. Calculate their focal lengths.   2

   (c) Give Stokes' treatment to explain the change of phase when reflection takes place at a denser medium.   2

(d) How does colour appear in thin films?   2

(e) Define dispersive and resolving power of a grating.   2

(f) What do you understand by double refraction or birefringence?   2

3. *(a)* What is spherical aberration of a lens? Find the condition for minimum spherical aberration of two thin lenses separated by a distance.   1+2=3

   (b) Give the relative merits and demerits of a Ramsden and Huygens eyepiece. Why is Huygens eyepiece called a negative eyepiece?   3+1=4

   (c) Describe the formation of Newton's ring by reflected monochromatic light. Describe an expression for the radius of the *n*th dark ring formed by reflection and how you determine the wavelength of monochromatic light using Newton's ring.   2+2+2=6

(d) Explain the principle of formation of fringes in Fabry-Perot interferometer. Deduce an expression for intensity distribution in fringes. 3+4=7

4. (a) What is a zone plate? Give the theory of the zone plate. Derive an expression for its focal length. Compare the zone plate with a convex lens. 1+3+1+2=7

(b) What is plane diffraction grating? In Fraunhofer diffraction pattern formed by a single slit, suppose that the slit width is 0·03 cm and the wavelength of light used is 6×10^{-5} cm. Find the diffraction angle for the first dark band. 2+3=5

5. (a) Describe the method of producing linearly polarized light, circularly polarized light and elliptically polarized light. Explain how they can be distinguished from each other. 6

(b) Write short notes on the following : 2×2=4

(i) Non-reflecting film

(ii) Malus' law

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